Adult/Pediatric Airway Skill Station for RMRTS 9/17/09

Adult Supply List

1. Adult airway mannequin head
2. Cath tip suction
3. Rigid tip (Yankauer) suction wand
4. Sp02 finger probe
5. Oral pharyngeal airways : various adult sizes
6. Nasal pharyngeal airways: various adult sizes
7. King Airway
8. LMA
9. Combitube
10. Cobra tube
11. Adult endotracheal tubes (sizes 6 through 8.5mmid)
12. Adult stylet
13. Gum elastic bougie
14. Laryngoscope handle
15. Curved and straight (mac and miller) blades
16. colorimetric ETC02

Pediatric Supply List

1. Pediatric and/or child airway mannequin head
2. Cath tip suction
3. Rigid tip (Yankauer) suction wand
4. Sp02 finger probe
5. Oral pharyngeal airways : various pediatric sizes
6. Nasal pharyngeal airways: various pediatric sizes
7. King Airway pediatric sizes
8. LMA
9. Cobra tube pediatric sizes
10. Pediatric endotracheal tubes (sizes <6mmid)
11. Pediatric stylet
12. Gum elastic bougie
13. Laryngoscope handle
14. Pediatric Miller intubation blades
15. colorimetric pediatric ETC02

Teaching Plan

Due to anticipated class size, we have combined the adult/pediatric so that there aer 6-7 identical stations amongst which to divide students. You have about 30 minutes to present the combined adult/pediatric airway topic. Utilize case scenarios to progress the observers through the airway assessment and adjunct use. Each piece of airway equipment should be discussed in terms of its indications, contraindications, deployment and post placement assessment. Initial anatomy and physiology is used to apply critical thinking to airway and ventilation support. Ask questions of the group, ask for volunteers to demonstrate. If no one volunteers answers or demos, you should proceed to answer, describe and demonstrate the process.

(The Cobra is NOT used in EMS in the USA now but can be discussed.)

The persons at the skill station will be a mixture or EMS and midlevel providers. Not all the EMS providers will have airway endorsements. The objectives for EMT airway endorsements (summarized below) can be used as the guide for this station so as to supplement the knowledge-base of any endorsed EMT and offer advice to non-endorsed EMTs on how to be effective with their skill set and of assistance to endorsed providers. All the MT Endorsement documents for DLA, ETT, IV/IO are in this booklet. The content below is cross referenced to the objectives. At the point where definitive airway endorsement would be needed to do a skill at the stationn the skill station mentor can elicit who in the group is able to place airways and utilize them as demonstrators.

MT BOME EMT-B Airway Endorsement Objectives (minus CPAP)

1. **Explain the primary objective of airway maintenance**
2. **Identify commonly neglected Prehospital skills related to airway**
3. **Identify the anatomy and functions of the upper airway**
4. **Describe the anatomy and functions of the lower airway**
5. **Explain the differences between the adult and pediatric airways**
6. **Define normal tidal volumes for adult, child, infant**
7. **Explain the relationship between pulmonary circulation and respiration.**
8. **List the factors that cause decreased oxygen circulation in the blood**
9. **List the factors that increase and decrease carbon dioxide production in the body**
10. **Describe the measurement of oxygen in the blood**
11. **Describe the measurement of carbon dioxide in the blood**
12. **List the factors that affect respiratory rate and depth**
13. **Describe the voluntary and involuntary regulation of respiration**
14. **Describe the causes of upper airway obstruction**
15. **Define the normal respiratory rates for adult, child, infant**
16. **Describe causes of respiratory distress IN TRAUMA**
17. **Describe indications, contraindications, advantages, disadvantages, complications, equipment, and technique for using a dual lumen airway or King Airway**
18. **Describe the special considerations in airway management and ventilation for the patients with facial injuries**
19. **Describe the special considerations in airway management and ventilation for pediatric patients**

Adult Scenario

A 22 yr old male has crashed his vehicle into a concrete bridge abutment at an unknown speed. He has remained in the vehicle. His GCS is 11 (E=3 V=3 M=5). He was unrestrained. The windshield is starred. He has a large bleeding laceration of his lip and nose. He smells of alcohol. He is not cooperative. His breathing is noisy and he is coughing/spitting/drooling blood and mucous. His VS are 120/70 HR 100 RR 20. First responder personnel have collared/boarded and extricated him and applied a 100% NRB oxygen mask. He screams when his chest is touched and there is a crepitance on the left chest.

Pediatric Scenario

A 5 yr old 20kg male has been thrown into a damp irrigation ditch from a rollover MVC. His GCS is 10 (E=3 V=3 M=4). First responder personnel have collared/boarded him and applied a 100% NRB oxygen mask. He has extensive mud and grass on his face with facial lacerations and bruising. He has vomit on his face. His VS are 100/60 HR 125 RR 35 and noisy and there is increased use of diaphragm

Questions to prompt group participation

1. **(Obj. 1 and 14) What principles of airway maintenance does these patient scenario illustrate? What pieces of information in the scenario indicate airway needs?**
    a. **Adult**
        i. **GCS marginal**
            1. **What is the risk of assuming intoxication alone if cause of low GCS?**
            2. **Would you do anything differently if he is "just drunk?"**
        ii. **Facial trauma and bleeding**
        iii. **Marginal ability to protect airway**
        iv. **Chest wall pain and crepitance**
        v. **How does RR of 20 change your assessment? What is a normal RR for an adult (Obj. 15)**
    b. **Pediatric**
        i. **GCS marginal: what is GCS trigger for intubation?**
        ii. **Facial trauma and bleeding**
        iii. **Marginal ability to protect airway**

iv. Is RR of 35. Is this high for his age? (Obj.15)
v. Does the fact that he is breathing on his own mean he needs or doesn't need airway and breathing support

c. What are the pediatric airway/breathing differences? (Obj.5)
i. Larger head/occiput = crimped airway
ii. Larger tongue = earlier occlusion (Obj. 3 and14)
iii. Cricoid is so narrow that some don't need a cuffed tube
iv. Airway diameter estimate is size of pinky finger
v. Alveoli collapse earlier in blunt chest trauma or underventilation (Obj. 7)
vi. Twice the 02 consumption rate so less tolerance of hypoxemia than adults
vii. Chest wall muscles are immature. Use diaphragm more
viii. Extensive pulmonary injury in the absence of fracture (Obj.7)

2. (Obj. 2)What is the first airway maneuver (and "essential skill" per PHTLS)?
a. Demonstrate a chin lift/ jaw thrust and discuss its rationale
i. Tongue (Obj. 3 and 14) : What is the impact of altered level of consciousness on the integrity of the upper airway?
ii. Inspection for foreign matter
b. Pediatric : Positioning due to head size? Line up shoulders with ear canals
c. Discuss now to suction without inducing vomiting

3. Is either a candidate for an OPA?
i. How do you know if pt has a gag reflex?
ii. Indications: cannot protect own airway; prevent ETT biting
iii. Contraindications: conscious or semi conscious
iv. Demonstration
v. When would this patient be a candidate for OPA?
vi. How does OPA help with efficient BVM ventilations? (Obj.3)

4. Is he a candidate for an NPA?
i. Indications: unable to maintain own airway
ii. Contraindications: facial trauma; conscious; obligate nose breathers (peds)
iii. Demonstrate insertion

5. Once and NPA or OPA is in, is suction still needed? Do they assure patency?

6. Is BVM breathing still needed if a patient is breathing "on his own." How do you determine who needs BVM breathing support and who does not?

a. **If a patient is breathing "on their own", how do you determine if rate and depth are sufficient?**
    i. **if RR and depth meet perfusion needs and maintain normal ABG……but you don't have that immediately available**
    ii. **Begin with an explanation of 02 and C02 exchanged**
b. **How do 02 and C02 exchange at an alveolar level? (Obj. 7)**
    i. **Refer to image of alveolus**
    ii. **Discuss how alveoli collapse in underventilation or in pulmonary contusion and chest wall trauma so that 02 and C02 cannot exchange**
    iii. **Discuss how alveoli get full of exudate in chest trauma**
    iv. **Discuss how circulation will "shunt" away from collapsed alveoli and how that translates into decrease 02 and increased C02 in blood.**
    v. **Discuss the negative impact of chest trauma and decreased mentation, in these case scenarios, on C02 and 02 exchange (unconscious patient with altered respiratory rate, drive, pattern combined with underventilated or damaged alveoli)**
    vi. **What is Sp02? (02)**
        1. **Validity is influenced by: motion, moisture, poor perfusion, cold, vasoconstriction, anemia/blood loss**
        2. **What affects the binding of oxygen to hemoglobin (Obj.8)?**
        3. **How can 02 be measured? ABG? Sp02? (Obj.10)**
        4. **Show 02 dissociation curve**
            a. **Acidosis benefits normal circulation in that Hgb unloads at tissue level of working "acidotic and hot" muscle. Acidosis due to resp depression and underventilation results in less 02 carried to cells.**
            b. **Shift to LEFT means LOAD: the Hgb molecule doesn't release the 02 as easily**
            c. **Shift to RIGHT means RELEASE. The Hgb molecule is less likely to bind the oxygen.**
            d. **Either state results in altered perfusion at cellular level. For this station, emphasis is on impact of pH and role of C02 in creating pH alterations.**
            e. **"Shock" is underperfusion and the "perfusion" this refers to is the delivery of Oxygen. A valid Sp02 is important**
    vii. **What is C02 and ETC02? (Obj. 11)**
        1. **What normally drives respiratory rate? (Obj. 9 and 13)**
            a. **Blood level of C02**
            b. **Fight/flight/fear/pain increases RR**
            c. **TBI compensation can include increased RR**

viii. **ETCO2 / colorimetrics "gold is good"**

1. **Discuss that monitor is placed between the BVM and the ETT**
2. **Normal ETCO2 is 30-40mmHg and the monitor is often 2-5mmHg less than a measured ABG paC02.**
3. **Affected by anything that would alter the amount of C02 that can get from the alveolar blood into the exhaled air**
    a. **Hypotension**
    b. **High chest pressure in chest trauma**
    c. **Hemopneumothorax**
4. **What is normal adult minute volume? (about 7/lpm) (Obj.6)**
    a. **Adult BVM delivers about 1600cc per compression (adult) with a PERFECT seal!**
    b. **If an average breath is about 500cc, then an adult would have to breath about 14/min to adequately ventilate**
    c. **What is the BVM rate for an adult? (10)**
        i. **What is the BVM rate for an adult who has signs of cerebral herniation? (20)**
        ii. **What are those signs?**
        iii. **Posturing on one side and/or a blow pupil with GCS < 8**
        iv. **Why do we increase the RR?**
        v. **Because reducing C02 reduces extra intracranial blood flow**

    d. **BVM deliver about 600-700cc (peds) and 200-300(infant) per compression with a PERFECT seal!**
    e. **What is the BVM rate for a child of this age?**
    f. **So, do you consider BVM support for patients who**
        i. **have low GCS and are breathing < normal ?**
        ii. **have low GCS, RR< Normal and low Sp02?**
    g. **What is the risk with overventilation? (Obj. 9)(see curve and relate to decreased cerebral blood flow in TBI)**
    h. **What is the impact of underventilation? (Obj.9)(see impact acidosis on 02 diss. curve)**
    i. **Is there a risk of insufflating stomach? How does that impact ventilation?**

7. **What are the dual lumen / alternative airways? (Obj. 17)**
    a. **Combitube: works in esophagus or trachea**

i. 2 sizes : regular and SA
ii. Indications: apneic patient > 5 feet tall (the SA model can do a patient between 4 and 5 ½ feet tall.
iii. Contraindications: outside size range, responsive, intact gag, esophageal disease, ingestion of caustics
iv. Demonstrate. Discuss complications and removal (emesis)

b. King Airway: works only if in esophagus
i. Height based sizing: 35 inches to over 6 feet tall.
ii. Only one port to inflate 2 balloons
iii. Two forms: LT-D and LT(S)-D. The S form has a side lumen for use as a gastric tube
iv. Both have a pharyngeal and distal cuff.
v. Indications: same as Combitube but patient does not need to be apneic.
vi. Contraindications: same as Combitube except patient can have spontaneous respiratory rate
vii. Demonstrate. Discuss complications and removal

c. LMA: laryngeal mask airway (developed in 1981)
i. For unconscious or seriously obtunded adults and children
ii. Can be inserted blindly
iii. Forms a low pressure seal around laryngeal opening into trachea
iv. Does not protect against aspiration
v. Does not tolerate high pressure positive ventilation
vi. Not used in EMS as much in US as in Europe.
vii. Lots of contraindications due to pressure limits and aspiration risks
viii. Demonstrate: Discuss complications and removal

d. Cobra PLA : head designed to hold soft laryngeal tissues and epiglottis out of the way and ventilation is achieved through the slotted openings
i. Neonate sizes to adult
ii. Does not protect from regurgitation/aspiration since there is no cuff capping the trachea as in an ETT
iii. Indications/contraindications are similar to King and Combitube
iv. Insertion is also similar.

8. Endotracheal intubation (ETT is an additional EMT endorsement)
a. Indications in trauma: inability to protect airway; significant oxygenation or ventilation deficiency
b. Contraindications: untrained personnel; no indications; close to a facility that is trained while you provide interim support
c. Protocol isn't a replacement for case by case analysis of risk /benefit for each patient. (Just because you can doesn't mean you should)
d. Non trained personnel can support with

i. good airway suction, other adjuncts and efficient BVM
ii. the intubation process: suction, cricoid pressure, inline stabilization

e. Orotracheal vs nasotracheal
   i. Orotracheal: hyperextension risk at C1-2 and 5-6 so may not be optimal in trauma
   ii. Nasotracheal:
      1. can be used if conscious, breathing, and with intact gag
      2. must be breathing for blind insertion into trachea
      3. no literature evidence of issues with nasotracheal insertion in facial trauma but there is that risk

f. Meds with Intubation: Encourage independent study of each meds dosages and complications
   i. Sedatives: to relax protective reflexes (Versed, Valium, Fentanyl, Morphine)
   ii. RSI: Rapid Sequence Intubation combines sedatives with skeletal muscle paralyzing agents
      1. requires additional time to perform and additional training to learn
      2. Indicated if: personnel are trained and patient can't be intubated without it
      3. Contraindicated if
         a. there are effective alternatives
         b. severe facial trauma indicates intubation will be a challenge
         c. neck trauma means a failed intubation has no surgical airway rescue back-up
         d. allergic to the meds
         e. already in shock and could crash BP with the meds (relative)

g. Demonstrate process.
   i. Reinforce the use of non-endorsed personnel with providing hyperoxygenation and cricoid pressure
   ii. Discuss tube size selection and cuffed vs uncuffed in pediatrics
   iii. Discuss verification of placement: breath sounds, CXR, ETCO2, increased risk right mainstem intubation/dislodgement with uncuffed tubes

Back to (and summarize) the scenario

1. Suction OPA, maybe not NPA……for patency
2. BVM support as indicated by Sp02? RR?

3. **If his GCS went to 8, how would care change?**
4. **If he vomited, how would care change?**
5. **What if you are only 15 minutes from a hospital? Would you go for aggressive (tube) airway management?**
    a. **What if you are at the scene waiting for ALS or ALS/flight and they were 15 min out ? If you were experienced in DLA or ETT? If you weren't?**
    b. **What if you are at a facility waiting for flight?**
    c. **What if you are at a facility and flight can't come and you are planning ground transport?**

ABG Interpretation

If there is any time left, consider reviewing this topic in a very general fashion. Acid Base balance is part of determining the end points of resuscitation. Ongoing acidosis is an indicator for a poor outcome and/or insufficient resuscitation. Normal human enzymatic processes and nerve conduction and cardiac depolarization and so many other processes require a normal pH to function. So ABG analysis is an indicator or an acute problem that, if not fixed, could result in a bad outcome later.

ABG components and a Four Step Method for Interpretation

1. **Step One (1): pH: the acidity or alkalinity of the blood. Blood is alkaline normally with a pH of 7.35-7.45.**
    a. **<7.35 = acidosis**
    b. **>7.45 = alkalosis**
2. **Step Two (2): paC02: dissolved in blood. Determines the respiratory impact on the ABG result.**
    a. **<35**
        i. **Contributes to an alkalosis**
        ii. **Raises pH**
        iii. **Or will be a compensatory mechanism to neutralize a low pH**
    b. **>45**
        i. **Contributes to acidosis**
        ii. **Lowers pH**
        iii. **Or will be a compensatory mechanism directed towards neutralizing a high pH**
3. **Step Three(3): Assume metabolic cause when a respiratory cause for pH is ruled out in Step 2**
    a. **pH High? Alkalosis**
        i. **High paC02 = metabolic cause**

   ii. **Low paC02 = respiratory cause**

b. **pH Low? Acidosis**
   i. **High paC02 = Respiratory cause**
   ii. **Low paC02 = Metabolic cause**

c. **If paC02 is ABNORMAL and pH is NORMAL……there has been compensation**
   i. **pH >7.4 = compensated alkalosis**
   ii. **pH < 7.4 = compensated acidosis**

4. Step Four (4) use HCO3 to verify metabolic issue

d. **HC03: the bicarbonate ion which is part of balancing acids and bases in the body. Can be retained or excreted by kidney or consumed in compensation reactions. Like alkaseltzer for acid indigestion. A neutralizer**

e. **Normal is 22-26**

f. High **HCO3-** causes alkalosis (raises pH), or neutralizes acidosis. This renal response is slow

g. Low **HCO3-** causes acidosis (lowers pH), or neutralizes alkalosis.